REMARKS

Claims 1-33 are pending in this application. No claims have been amended. New claims 32 and 33 have been added. Claim 32 specifies that the CDO is an ILD layer. Support for this claim is found at paragraphs 0002 and 0022. Claim 33 specifies that the deposited CDO film has a carbon-carbon triple bond to silicon oxide bond ratio of about 0.05% to 20% based on FTIR peak area. Support for this claim may be found at paragraph 0037.

35 U.S.C. § 103 Rejections

Claims 1-16 and 18-31 have been rejected under 35 U.S.C. § 103 as being unpatentable over U.S. Patent Publication No. 2006/0110931 to Fukazawa ("Fukazawa"). Claim 17 was rejected over Fukazawa in view of U.S. Patent No. 7,087,271 to Rhee et al. ("Rhee"). Applicants address the rejections below.

The present claims relate to forming preparing a carbon doped oxide dielectric layer having a low dielectric constant and low residual stress. CDO layers are silicon oxide-based films that are used, e.g, as interlayer dielectrics (ILDs). Low-k CDO layers may be formed by doping silicon dioxide with various hydrocarbons. However, low-k CDO films typically have inferior mechanical properties due to the presence of ending methyl groups ($-CH_3$), which are incorporated in the film in order to lower the k value of CDO materials. The present invention provides addresses this problem by providing methods of forming low CDO films that have good mechanical properties, e.g, in claimed embodiments, having a stress magnitude of less than about 50MPa.

The Examiner has rejected independent claims over Fukazawa, contending that it would be obvious to "use frequency, separation gap, temperature and pressure" as recited in applicants claims. The Examiner also contends that Fukazawa fails to disclose residual tensile or compressive stress of magnitude of less than about 50 Mpa, but that "the same material would be treated in the same manner and therefore the recited results would be obtained."

Applicants respectfully traverse the rejection. As indicated, Applicants' claims relate to the formation of carbon-doped silicon oxide layers, i.e., layers with silicon-oxide network that is doped with carbon, that is a carbon impurity added at relatively low concentration. As indicated above, these low-k films are often used as ILDs .

Fukazawa, by constrast, relates to silicon carbides that are doped with oxygen. As described in Fukazawa, silicon carbides are used as barriers to prevent copper from diffusing into ILD layers and/or etch stop layers in damascene patterning of ILD layers. (See paragraphs 0016, 0019-0022, 0103 and 0104). The properties and uses of silicon carbide-based structures differ greatly from silicon-oxide based structures. The mechanical strength of silicon carbide layers such as those formed in Fukazawa does not tend to be an issue, because of the greater density and mechanical strength of silicon carbide-based structures. The structural distinction between the oxide layers and carbide layers is important as, for among other reasons, it allows etch selectivity between the oxide and carbide layer. Thus, the carbide layers may be used as etch stop layers as described in Fukazawa in a process to etch ILD CDO layers.

Applicants traverse the Examiner's contentions that it would be obvious to use the "use frequency, separation gap, temperature and pressure" as recited in applicants claims, and that "the same material would be treated in the same manner and therefore the recited results would be obtained." As discussed above, the material in Fukazawa is significantly different from the carbon doped oxide recited in Applicants' claims, and so would not be expected to obtain the same results. Further, Fukazawa explicitly teaches away from forming an oxide-based structure:

> Also, by reducing the distance between the electrodes, using low-frequency RF power mixed with high-frequency RF power, and/or using a reaction gas containing no oxygen-supplying gas and/or crosslinking gas, a silicon carbide film (Si--C based structure), not a low-k film (Si--O based structure), can be formed, and the film density can increase. (paragraph 0027).

In short, nothing in Fukuwaza teaches or suggests forming a silicon oxide, nor addresses the problem that Applicants' invention addresses, namely forming carbon-doped silicon oxide layers with high mechanical strength. As indicated above, silicon carbide is a very hard and strong material; the mechanical strength of silicon carbide layers such as those formed in Fukazawa is not an issue. Rhee also relates to silicon carbides; at least for this reason, Rhee does not cure the deficiencies of Fukazawa.

For at least these reasons, Applicants submit that 1-31 are patentable over the cited art. In addition, newly added claims are submitted to be patentable over the cited art. New claim 32 specifies that the CDO layer is an ILD layer. As indicated above, this is not taught or suggested by Fukazawa. New claim 33 specifies that the deposited CDO has a carbon-carbon triple bond to silicon oxide bond ratio of about 0.05% to 20% based on FTIR peak area. This is not taught or suggested by the cited art.

Conclusion

Applicants believe that all pending claims are allowable and respectfully request a Notice of Allowance for this application from the Examiner. Should the Examiner believe that a telephone conference would expedite the prosecution of this application, the undersigned can be reached at the telephone number set out below. If it is determined that any additional fees are due, the Commissioner is hereby authorized to charge such fees to Deposit Account 500388 (Order No. NOVLP091).

Respectfully submitted,
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